

# **Restoration of the Salton Sea**

**Volume 2:      Embankment Designs and Optimization Study**

**Appendix 2D: Risk Analysis**

**Attachment B: Event Trees**

**Prepared for:  
U.S. Department of the Interior  
Bureau of Reclamation  
Lower Colorado Region  
Boulder City, Nevada**

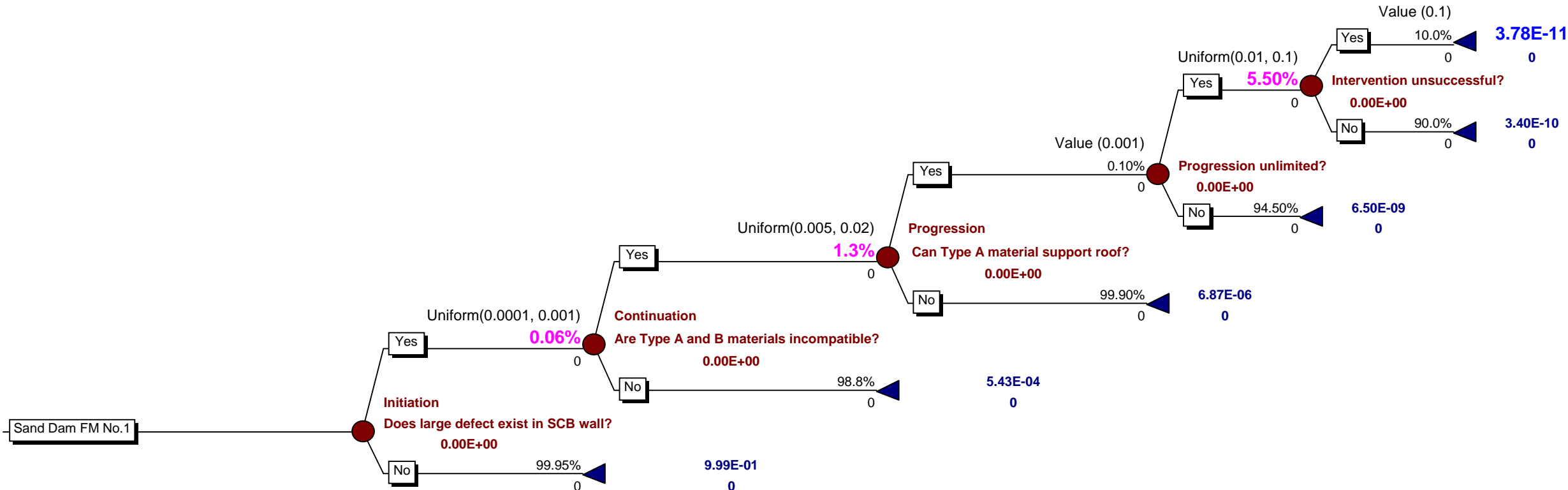
**Prepared by:  
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Golden, CO 80401  
Project No. 71100**

**May 2007**

Salton Sea Restoration Project  
Embankment Alternatives Optimization Study

Sand Dam Embankment with Stone Columns  
FM No. 1 Static - Internal Erosion (Piping) of Embankment

Annualized Loss of Life (ALL) 0.00E+00  
Annualized Probability of Failure (APF) 3.78E-11

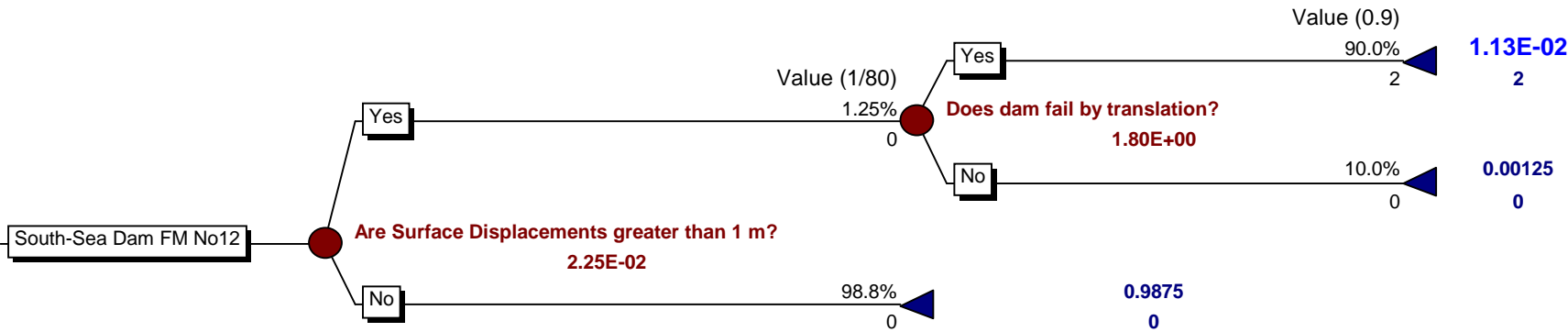


Annualized Probability of Failure	Annualized Loss of Life
3.78E-11	0.00E+00

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South-Sea Dam  
FM No. 12 Seismic - Offset and Translation of Embankment

Annualized Loss of Life (ALL) 2.25E-02  
Annualized Probability of Failure (APF) 1.13E-02



Annualized Probability of Failure	Annualized Loss of Life
1.13E-02	2.25E-02

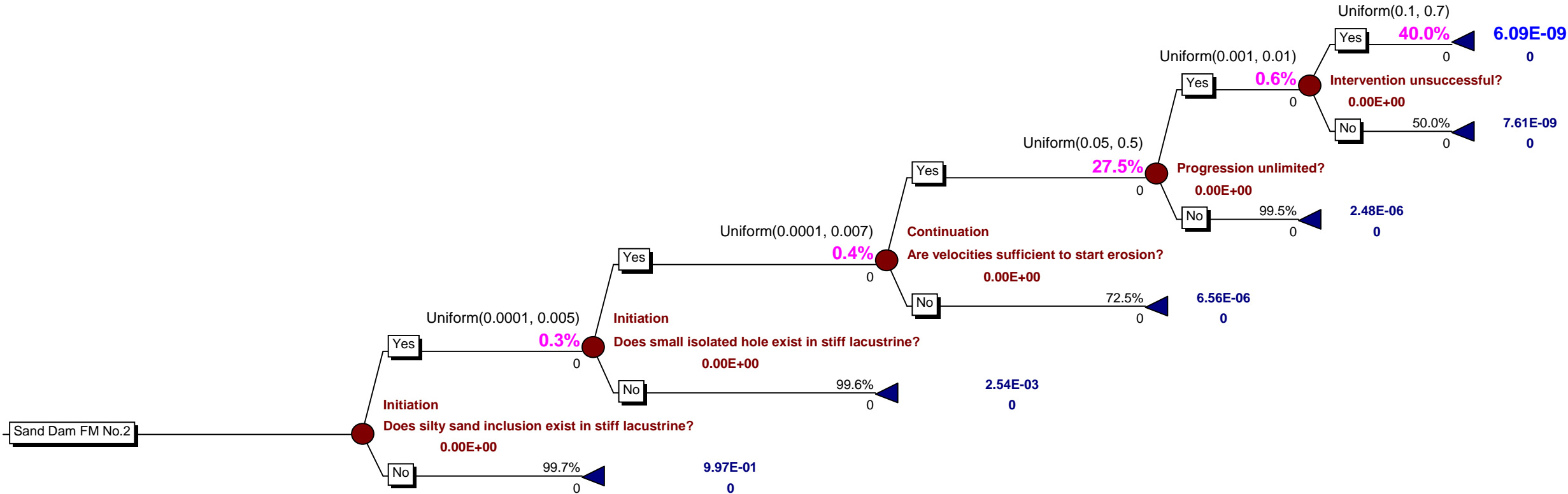
LOL Estimates (Pert Distribution)

Low Bound	Best Estimate	Upper Bound
0.28	1.5	3.5

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Sand Dam Embankment with Stone Columns  
FM No. 2 Static - Internal Erosion of Foundation Materials

Annualized Loss of Life (ALL) 0.00E+00  
Annualized Probability of Failure (APF) 6.09E-09



Annualized Probability of Failure	Annualized Loss of Life
6.09E-09	0.00E+00

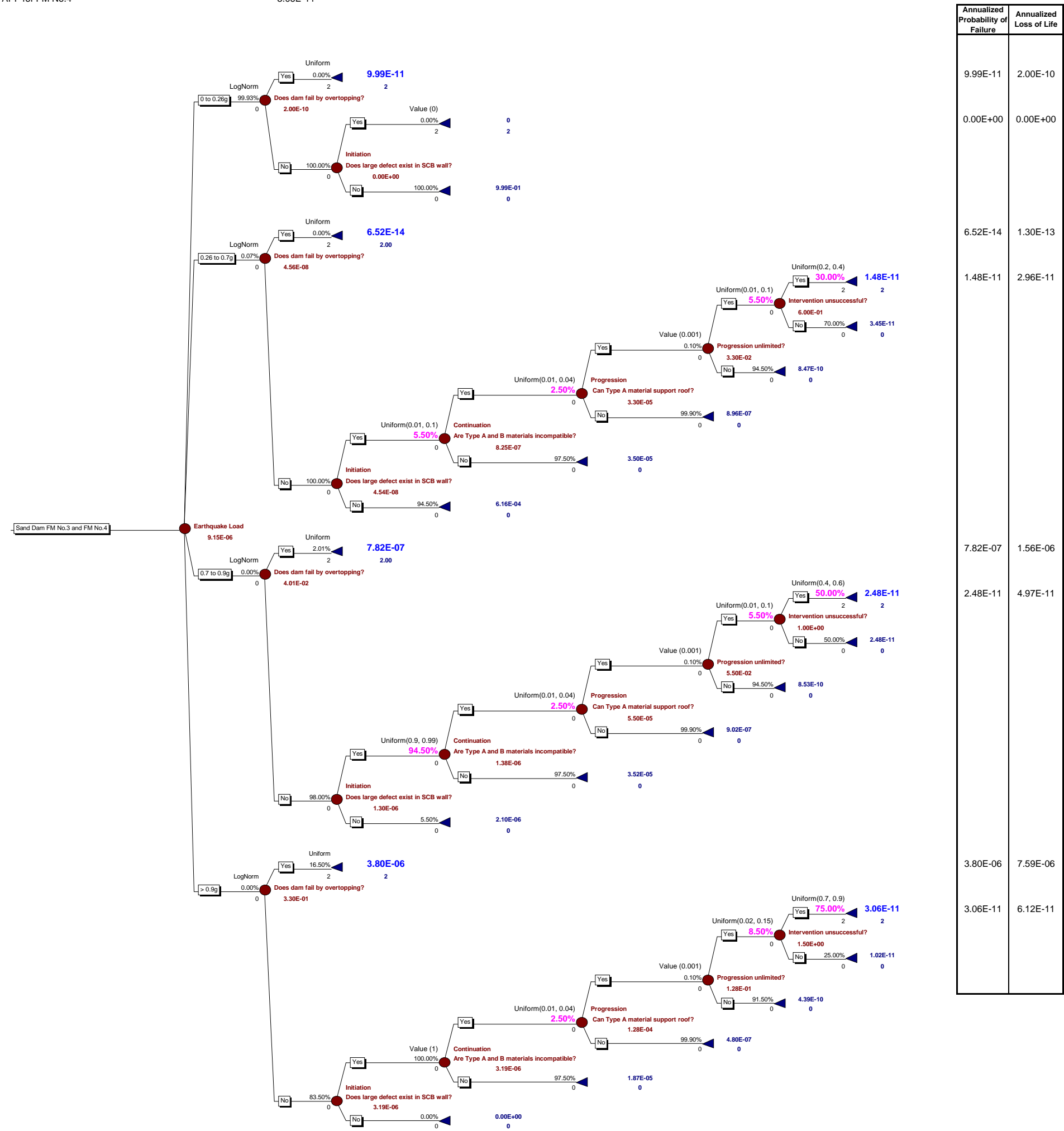
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Sand Dam Embankment with Stone Columns  
FM No. 3 Seismic - Deformation and Overtopping of Embankment  
FM No.4 Seismic - Deformation and Internal Erosion of Embankment

Annualized Loss of Life (ALL)  
Annualized Probability of Failure (APF)  
ALL for FM No.4  
APF for FM No.4

7.59E-06  
3.80E-06  
6.12E-11  
3.06E-11

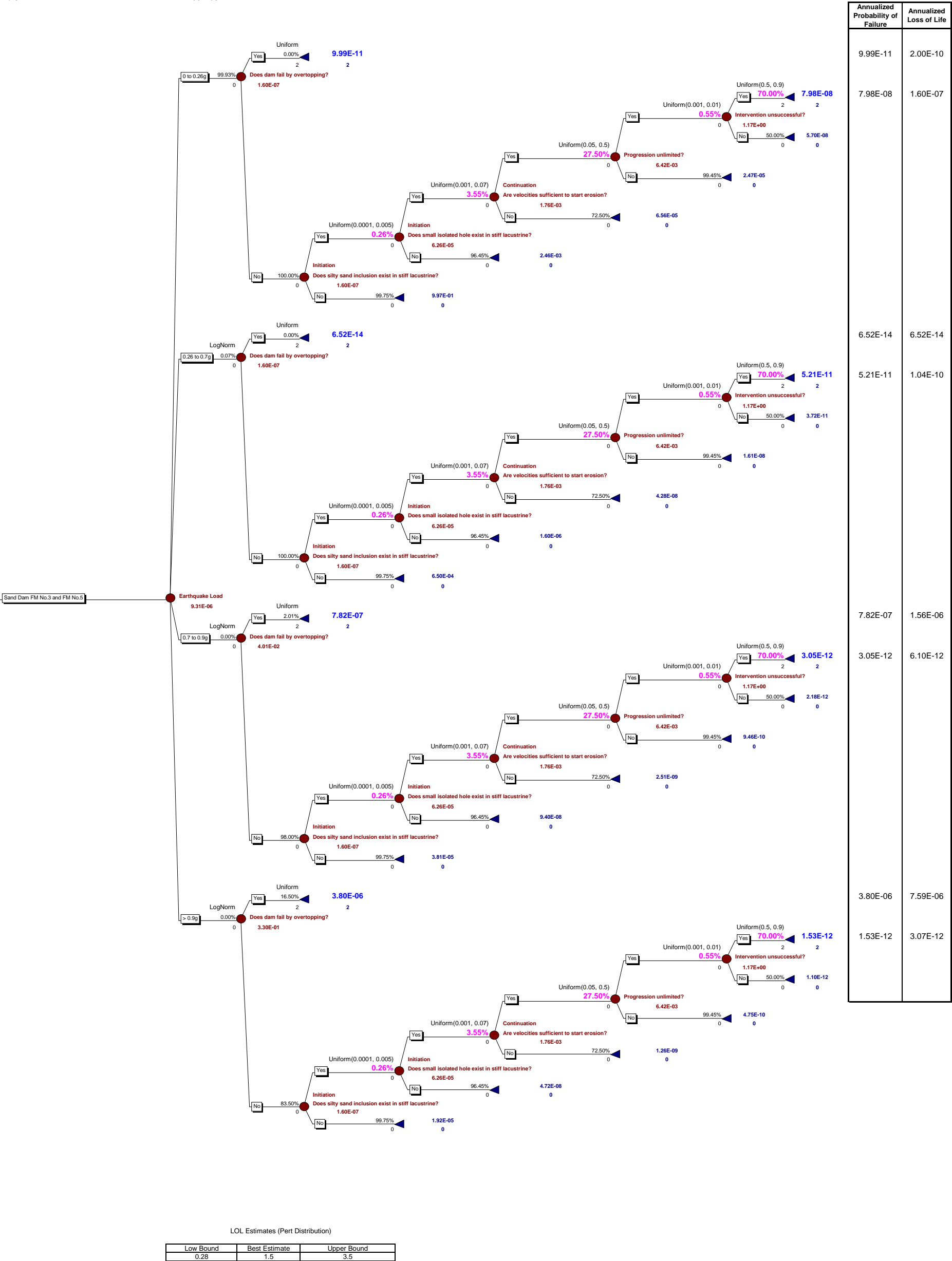
Failure mode FM No.3 is governing  
Failure mode FM No.3 is governing



Salton Sea Restoration Project  
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Sand Dam Embankment with Stone Columns  
FM No. 3 Seismic - Deformation and Overtopping of Embankment  
FM No.5 Seismic - Deformation and Internal Erosion of Foundation

Annualized Loss of Life (ALL)	7.59E-06	Failure mode FM No.3 is governing
Annualized Probability of Failure (APF)	3.80E-06	Failure mode FM No.3 is governing
ALL for FM No.5	1.60E-07	
APF for FM No.5	7.98E-08	

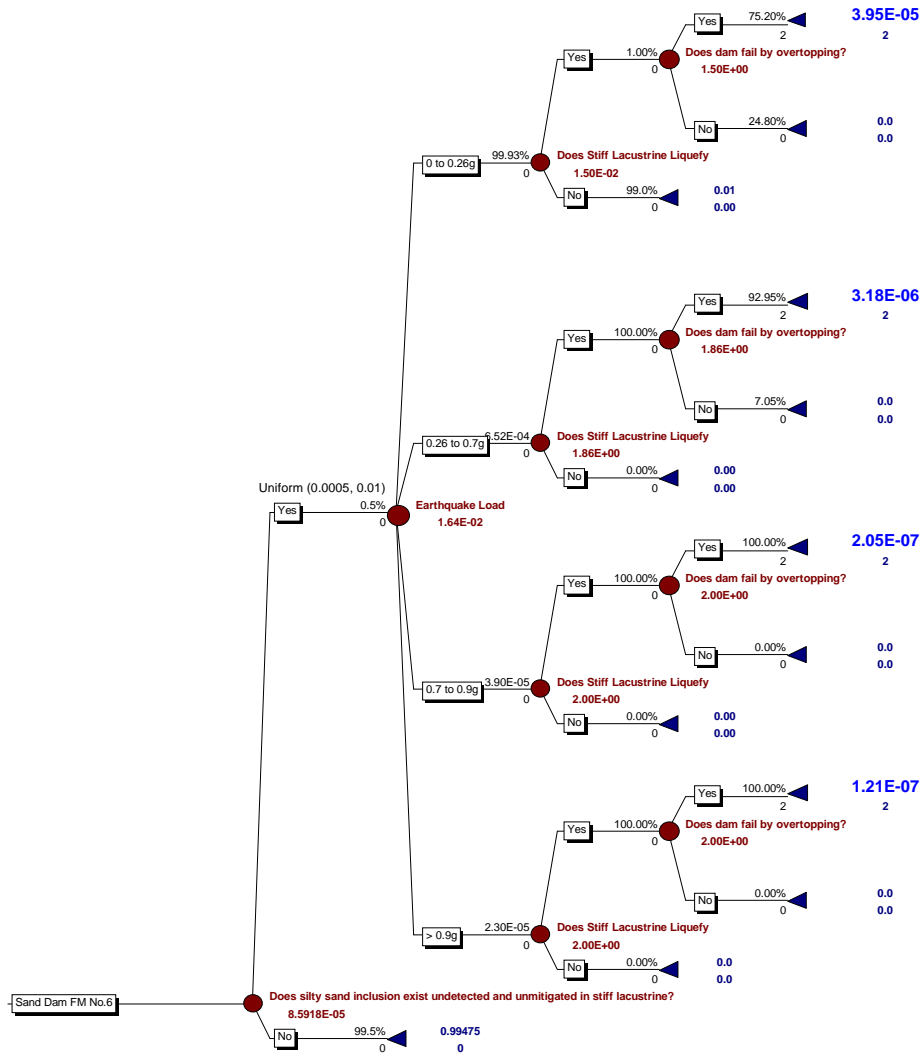


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**Sand Dam Embankment with Stone Columns**

**FM No. 6 Seismic - Liquefaction of Stiff Lacustrine, Seismic Deformation and Overtopping of Embankment**

Annualized Loss of Life (ALL) 7.89E-05  
Annualized Probability of Failure (APF) 3.95E-05



Annualized Probability of Failure	Annualized Loss of Life
3.95E-05	7.89E-05
3.18E-06	6.36E-06
2.05E-07	4.10E-07
1.21E-07	2.42E-07

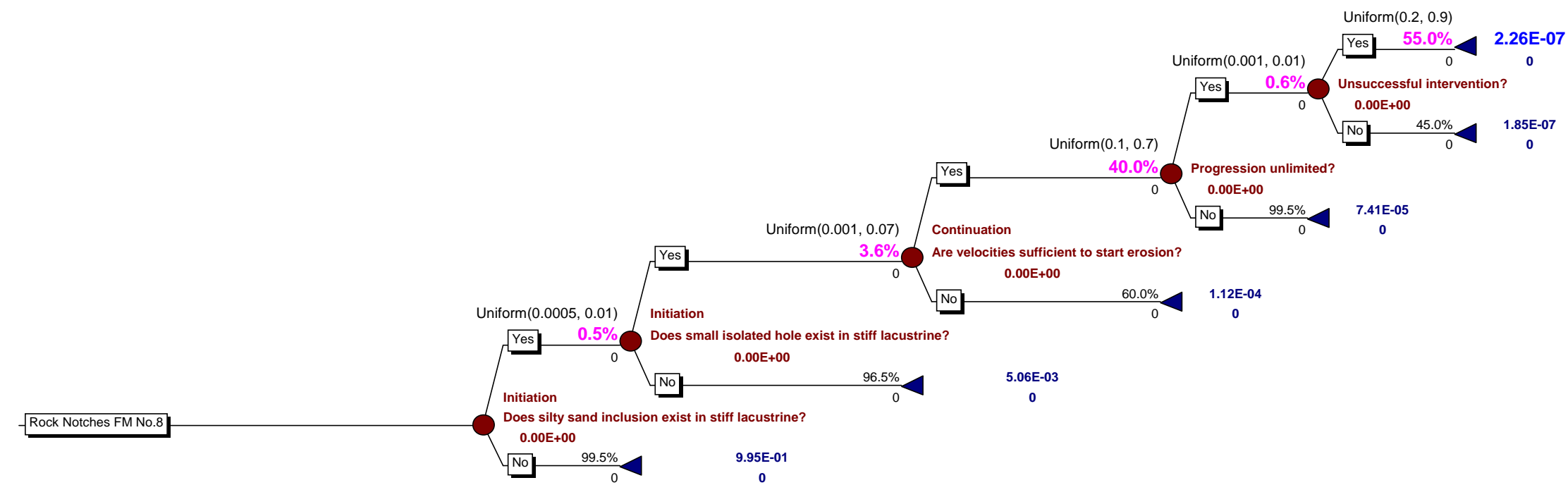
LOL Estimates (Pert Distribution)

Low Bound	Best Estimate	Upper Bound
0.28	1.5	3.5

Salton Sea Restoration Project  
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Rockfill Dam with Rock Notches  
FM No. 8 Static - Internal Erosion of Foundation Materials

Annualized Loss of Life (ALL) 0.00E+00  
Annualized Probability of Failure (APF) 2.26E-07



Annualized Probability of Failure	Annualized Loss of Life
2.26E-07	0.00E+00



Salton Sea Restoration Project  
Embankment Alternatives Optimization Study

Rockfill Dam with Rock Notches  
FM No. 9 Seismic - Deformation and Overtopping of Embankment  
FM No.11 Seismic - Deformation and Internal Erosion of Foundation Materials

Annualized Loss of Life (ALL)  
Annualized Probability of Failure (APF)  
ALL for FM No.9  
APF for FM No.9

6.09E-07  
3.05E-07  
2.00E-15  
9.99E-16

Failure mode FM No.11 is governing  
Failure mode FM No.11 is governing

